

# Pain NEWS



Spring 2004

A A N S / C N S S e c t i o n o n P a i n

[www.neurosurgery.org](http://www.neurosurgery.org)

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## Message from Chairman



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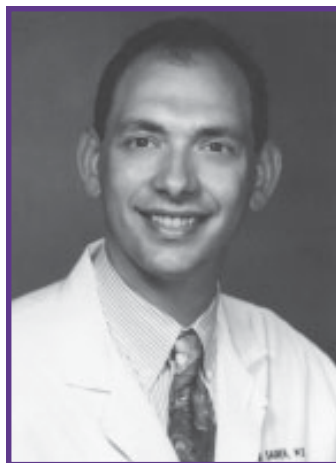
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Oren Sagher, M.D.

### Interventional Pain Medicine – a Uniquely Neurosurgical Realm

The surgical treatment of pain has its deepest roots in Neurosurgery. For decades, patients with medically refractory pain have sought the expertise of neurosurgeons for the performance of surgical treatments to alleviate their pain. In addition to the development and performance of ablative surgeries, neurosurgeons have also been instrumental in the development of less invasive treatments, such as electrical neurostimulation and intraspinal drug administration. In the process of developing these pain treatments, neurosurgeons have made fundamental contributions to the understanding of pain neurotransmission. There is little doubt that neurosurgery is the cornerstone of modern pain therapy.

Over the last several years, interest in surgical therapies has risen dramatically among non-surgeons. Anesthesiologists, physiatrists and neurologists have increasingly shown an interest in learning the surgical techniques necessary for implementation of intraspinal drug delivery, neurostimulation and percutaneous neuroablation. At the same time, neurosurgeons have shown increasing reluctance to take on the treatment of pain as a subspecialty interest. The result of this shift in demographics is a steady erosion in the neurosurgical presence in pain medicine.

While technical advances in implantable therapies such as drug administration pumps and neurostimulation devices have clearly put surgical analgesia within the reach of many more patients and a far greater population of physicians, the relative technical ease by which these therapies can be instituted also threatens pain medicine. To those clinicians whose only surgical tools are pumps and stimulators, it is too enticing to lump all clinical indications into those conditions treatable with one therapy or the other. Moreover, the lack of the surgical “glitz” factor deters many neurosurgical residents from entering this fertile field. Consequently, there is a significant potential for the dumbing-down of pain medicine, the consequences of which may include loss of expertise in other effective surgical techniques such as DREZ lesioning, cordotomy, and myelotomy. In addition, the performance of surgical procedures on the nervous system by physicians who have not had a surgical residency has a corrosive effect on the field in general, since good surgical technique cannot be taught in short courses, and the results of such technical procedures may be influenced by the experience and training of the non-surgical practitioners who are performing them.

It is important that neurosurgeons maintain an active interest in pain treatment. Neurosurgeons possess a unique combination of neuroanatomic knowledge and specifically honed psychomotor skills, essential to the practice of pain medicine. I encourage residents to take an active interest in the surgical treatments for pain (both modulatory and ablative). Also in this vein, I applaud the efforts of the American Board of Neurological Surgeons to track experience in pain procedures during residency more closely with the NeuroLog database. This effort will allow us to gauge how we are training residents in the surgical management of pain. The repertoire of procedures we teach the next generation of residents will strongly influence what role Neurosurgery will play in pain management in the coming years.

In an effort to increase neurosurgical involvement in pain, the Pain Section is offering

*cont. on Page 10 ...*

# Selected Open Papers

Annual CNS Meeting, San Diego 2003

## High Cervical Spinal Cord Stimulation for Complex Regional Pain Syndrome (CRPS) of the Upper Extremity

*Richard K. Osenbach, M.D., David C. Adamson, M.D. and Emily Davis, N.P.*

**Background Information:** Complex regional pain syndrome (CRPS) encompasses the conditions previously known as reflex sympathetic dystrophy (RSD) (CRPS Type I) and causalgia (CRPS Type II). Complex regional pain syndrome is a heterogeneous pain disorder that most commonly develops following trauma. It is characterized by spontaneous and/or evoked pain that typically involves a single extremity. Complex regional pain syndrome involves the upper extremity twice as frequently as the lower extremity. Although CRPS has a tendency to preferentially affect the distal portion of the painful extremity, pain patterns encompassing the entire extremity are quite common.

Treatment of CRPS can be both challenging and frustrating. Treatment is geared toward reduction in pain and functional restoration of the involved extremity. Many patients with CRPS can be adequately managed non-operatively, especially if aggressive intervention is employed early in the course of the disease. However, for those who fail standard treatment (physical therapy, medications, and regional anesthetic blocks, etc.), surgical treatment may be considered.

Spinal cord stimulation (SCS) in particular has been shown to be effective for the treatment of CRPS. Spinal cord stimulation can be performed with either percutaneous wire electrodes or plate electrodes that require an open surgical procedure for implantation and either method can be utilized. However, there are a number of considerations concerning the use of SCS for the treatment of upper extremity pain in general and CRPS in particular. Although placement of percutaneous electrodes is "minimally invasive", these wire type electrodes have potential drawbacks, especially when used in the cervical spine. Due to neck motion, they are highly subject to migration, resulting in loss of paresthesia coverage and high revision rates. Surgical leads represent a more stable alternative to percutaneous electrodes. However, for proper implantation in the subaxial cervical spine, they must be placed under local anesthesia, which can be difficult. Additionally, there is a potential risk of neurological injury, especially in the presence of any significant degree of spinal canal stenosis. Consequently, high cervical (C1-2) stimulation using surgically-implanted leads has evolved as a technique that eliminates many of the disadvantages of percutaneous cervical leads or subaxial surgical leads.

C1-2 electrodes have a number of advantages. When carefully implanted and anchored properly, they tend to be more stable and therefore require less frequent revision than percutaneous electrodes. Stimulation at C1-2 has been shown to consistently produce paresthesias that cover the entire upper extremity and it is even possible to stimulate the most

rostral cervical dermatomes. Consequently, unlike surgical leads placed lower, C1-2 electrodes can be implanted under general anesthesia, which is more convenient both for the patient and surgeon. Also, since the subarachnoid space is widest at this level, there is minimal risk of neurological injury. Indeed, C1-2 electrodes can usually be safely implanted even in patients with stenosis at lower levels of the cervical spine.

**Demographic Data:** Between July 2001 and October 2003, 14 patients with CRPS underwent SCS using C1-2 electrodes. There were six males and eight females with a mean age of 49 years (age range 37-68 years). The mean duration of symptoms was 61 months with a range of 9 months to 17 years. Ten patients (71%) had CRPS Type I (RSD) and four (29%) CRPS II (causalgia). Eight of 14 patients (57%) had a pain pattern that involved the entire upper extremity. Three patients had pain that involved an area from the elbow distally while the remaining three patients' pain was confined to the hand itself. The pain was unilateral in 12 patients (86%) and bilateral in two. All patients had undergone extensive conservative non-operative therapy before proceeding with SCS. The mean visual analog pain score (VAPS) (0-10) for the 14 patients was 8.8.

All patients underwent a screening trial prior to permanent implantation to determine effectiveness. Six patients underwent a prior screening procedure with a temporary percutaneous electrode to confirm effectiveness. These patients underwent implantation of the C1-2 electrode and internal pulse generator (IPG) during a single procedure. Eight patients were screened for one week using the permanent C1-2 electrode. After confirming appropriate paresthesia coverage of the pain pattern and satisfactory pain relief, they underwent implantation of the IPG as an elective second stage. A successful trial was defined by the ability to cover the majority of the pain pattern with paresthesias and pain reduction of a sufficient magnitude to justify implantation of the device on a permanent basis.

**Surgical Technique:** All procedures were performed prone under general anesthesia with the head secured in Mayfield pins. A unilateral exposure (bilateral for bilateral electrodes) was performed to expose the area from just above C1 down to the top of C2. The soft tissue was separated from beneath the ring of C1 and the C2 lamina, and ligamentum flavum resected between C1 and C2 to clear the epidural space. The electrode was inserted above C1 and passed retrograde beneath C1 and then directed under C2 and positioned such that the most rostral contact lay directly beneath the lower portion of C1. The electrode was anchored below the fascia to the interspinous ligament at C2 and again to the deep cervical fascia using the connection of the electrode to the extension wire. A strain relief loop was created between the two anchoring points. The IPG was implanted in the upper buttock and connected to the electrode with standard extension wires. For patients who had not been previously screened, temporary extension wires were connected to the electrode and tunneled out through a separate stab incision and the IPG was then implanted at a second stage following a successful screening trial.

**Follow-Up and Results:** Initial programming was performed during the first post-operative visit, usually 7 to 10 days following surgery. Bipolar stimulation was performed using an electrode combination that resulted in optimal paresthesia coverage. There was no obvious pattern to the electrodes chosen between patients. Stimulation parameters were selected that produced optimal stimulation. Amplitudes were quite variable (3-7 volts), pulse widths ranged from 200-400 microseconds, and frequency ranged from 30-90 Hz.

Thirteen patients (93%) experienced at least 50% reduction in their pain during the screening trial (percutaneous or C1-2 surgical lead) and underwent implantation of a full system. All patients experienced stimulation-induced paresthesias that covered 95-100% of their pain pattern. There were no adverse side effects of the stimulation. Four patients (21%) experienced device and/or surgical complications. All four after initially achieving complete paresthesia coverage, experienced either a slow or abrupt alteration in their stimulation pattern. Follow-up x-rays in three patients revealed electrode migration. Revision of the electrode recaptured the original stimulation pattern. Two of these migrations occurred early in the series before implementing the current anchoring technique. The other electrode became dislodged several weeks after surgery when the patient made a quick turning movement of the head, felt an electric shock in the neck and immediately lost stimulation. The fourth patient lost her stimulation pattern and was found to have abnormally high electrode impedance indicative of internal wire fracture. Replacement of the electrode resulted in restoration of the original stimulation pattern. One patient (who also had electrode migration) developed a localized infection that required removal of the IPG. After the infection had cleared he underwent revision of his migrated electrode and placement of a new IPG at a different site.

Thirteen patients who received a full permanent implant have been followed for an average of 15 months (range 7 to 27 months). Mean VAPS fell from 8.8 pre-operatively (range 7-10) to a mean of 2.6 (range 0-7) at the most recent follow-up. Ten of the 13 patients (77%) have maintained at least a 50% reduction in their pain. Three patients had gradual loss of initial pain relief despite complete paresthesia coverage of their pain pattern. These three systems were explanted at the patient's request.

**Conclusions:** High cervical stimulation using surgical leads

placed retrograde under C1-2 consistently results in a pattern of stimulation-induced paresthesias that covers the entire upper extremity. The electrodes can be placed accurately under general anesthesia with minimal morbidity. Electrode migration may still occur but may be significantly reduced by meticulously anchoring of the electrode at multiple points and creating a strain relief loop in the electrode. The magnitude of pain reduction with this technique appears at least comparable to that achieved with either percutaneous or surgical leads placed in the subaxial cervical spine for CRPS or other pain conditions that affect the upper extremity.

### **Failure Modes of Epidural Spinal Cord Stimulator Implants for Pain**

*Joshua M. Rosenow, M.D., Raul A. Rodas, D.O., Michael Stanton-Hicks, M.B.B.S., Ali R. Rezaei, M.D. and Jaimie M. Henderson, M.D.*

**Introduction:** Epidural spinal cord stimulation (SCS) is a commonly employed treatment for medically refractory pain syndromes. However, the incidence of long-term failures related to the implanted hardware has not been extensively studied.

**Methods:** We conducted a retrospective review of the electronic charts of all patients operated on for implantation or revision of SCS from January 1998 through December 2002. Information about the location and type of stimulator lead was recorded as well as reason for revision of the stimulator and action(s) taken. Lead types were separated into groups depending on method of implantation (percutaneous versus laminotomy) and location implanted (cervical, thoracic, thoracolumbar).

**Results:** Two hundred and ninety-six patients were operated on during the study period. These patients underwent a total of 577 operations (334 implants, 195 revisions, 47 removals), with a median of 2 operations per patient. The most common diagnosis was CRPS I, followed by failed back syndrome. Mean follow-up was 18.3 mos., 45.9% of patients required at least 1 revision, with 45.6% of those patients undergoing further revisions. A total of 330 electrodes were implanted (106 cervical, 224 thoracolumbar). Among cervical electrodes, breakage was significantly more common in laminotomy leads compared with percutaneous leads (53.8% vs. 10.9%,  $P < 0.001$ ). In addition, time to failure was significantly shorter (149.7 days vs. 422.3 days,  $p=0.04$ ) and they

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## **COLLEAGUES**

An application, in Adobe Acrobat format, for membership in the Joint Section on Pain can be located at [www.neurosurgery.org/sections/PN/Painapp.pdf](http://www.neurosurgery.org/sections/PN/Painapp.pdf) and on **page 11** of this issue.

We encourage you to forward this application to colleagues with interests in pain management.

Purpose of the Pain Section

- In the field of pain management, provides liaison and involvement with other specialties and organizations.
- Helps communications between AANS and CNS via joint section status.
- Provides help in resident curricula planning, especially in the area of pain management.
- Promotes Journal of Neurosurgery and Neurosurgery manuscript submissions in pain management.
- Fosters international communication and collaboration in neurosurgical procedures for pain.
- Reaches out to and encourages involvement by part of neurosurgery somewhat outside mainstream.
- Increases role of neurosurgeon in multidisciplinary field of pain management.

# Calendar of Events

## Symposium On The Diagnosis & Treatment of Craniofacial Pain & Trigeminal Neuralgia

**2004 Biennial Meeting  
Friday, April 30, 2004  
Orange County  
Convention Center  
Orlando, Florida**

### Future CNS Annual Meetings

2004 — San Francisco	October 16–21
2005 — Boston	October 8–13
2006 — Chicago	October 7–12
2007 — San Diego	September 15–20
2008 — Orlando	September 20–25
2009 — New Orleans	October 24–29



### Future AANS Annual Meetings

2004 — Orlando
2005 — New Orleans
2006 — San Francisco
2007 — Washington, D.C.
2008 — Chicago, Illinois
2009 — San Diego, California



### Other Pain Meetings of Interest

#### May 1–6, 2004 — Annual Meeting of the AANS

Location: San Diego, Calif.  
WWW: [www.aans.org/education/annual.asp](http://www.aans.org/education/annual.asp)  
E-mail: [info@aans.org](mailto:info@aans.org)  
Phone: 1.800.566.AANS (2267) or 847.378.0500

#### June 6–9, 2004 — Joint APS and Canadian Pain Society Annual Meeting (23rd APS Annual Scientific Meeting)

Location: Vancouver, British Columbia, Canada  
WWW: [www.ampainsoc.org](http://www.ampainsoc.org)  
E-mail: [info@ampainsoc.org](mailto:info@ampainsoc.org)

#### October 18–23, 2004 — Annual Meeting of the CNS

Location: San Francisco, Calif.  
WWW: [www.neurosurgeon.org/meetings/2004/index.asp](http://www.neurosurgeon.org/meetings/2004/index.asp)

#### March 29–April 4, 2005 — 24th Annual Scientific Meeting of the American Pain Society

Location: Hynes Convention Center, Boston, Mass.  
WWW: [www.ampainsoc.org](http://www.ampainsoc.org)

#### August 21–26, 2005 — 11th World Congress on Pain®

Location: Sydney, Australia  
WWW: [www.iasp-pain.org/05Cong.html](http://www.iasp-pain.org/05Cong.html)  
E-mail: [iaspdesk@juno.com](mailto:iaspdesk@juno.com)

### Pain Section

#### 2005 Research Fellowship for Neurosurgery Residents

- Eligibility:** Applicants must be M.D.s who have been accepted into, or who are currently in, approved residency training programs in neurological surgery in North America.
- Description:** The Fellowship is offered as a two-year commitment, totaling \$70,000 or a one-year grant of \$40,000.
- Supports:** Advanced Research in Pain.
- Sponsor:** Neurosurgery Research and Education and Foundation (NREF) and Medtronic, Inc.
- Submit applications to:**  
NREF, American Association of Neurological Surgeons, 5550 Meadowbrook Drive, Rolling Meadows, IL 60008-3852
- Deadline:** **Friday, October 29, 2004.**
- Application:** [www.aans.org/research/fellowship/nref.asp](http://www.aans.org/research/fellowship/nref.asp)

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were more likely to migrate (53.8% vs. 21.7%,  $p = 0.03$ ). A significantly larger proportion of cervical laminotomy leads fractured than those in the thoracolumbar region (53.8% vs. 9.1%,  $p = 0.01$ ). Thoracolumbar electrodes became infected significantly earlier than cervical electrodes (median 46.5 days vs. 448 days,  $p = 0.02$ ). Nine pulse generators were removed for infection an average of 4.2 months after implantation.

**Conclusions:** Current spinal cord stimulation system designs are associated with a significant long-term failure rate. Percutaneous leads appear to have a lower complication rate compared to laminotomy leads.

### Artificial Intelligence-based Program Makes the Diagnosis of Facial Pain Syndromes with High Accuracy

Farhad M. Limonadi, M.D. and Kim J. Burchiel, M.D.

**Introduction:** We have developed a classification system for facial pain syndromes consisting of seven categories: Trigeminal Neuralgia Type 1 (TN1), Trigeminal Neuralgia Type 2 (TN2), Trigeminal Neuropathic Pain (TNP), Trigeminal Deafferentation Pain (TDP), Symptomatic Trigeminal Pain (STN), Postherpetic Neuralgia (PHN), and Atypical Facial Pain (AFP), (1). The utility of an artificial intelligence based program to make a diagnosis was evaluated.

**Methods:** We designed an artificial neural network (ANN) with a highly distributed interconnection of adaptive nonlinear processing elements (PEs) for diagnosis of the type of facial pain syndrome. The connection strengths, also called the network weights, was adapted such that the network's output matched a desired response, namely the correct diagnosis. Thirty-six patients with complaint of facial pain were asked to fill out a questionnaire at the time of their initial visit. A facial pain diagnosis was then recorded by the senior investigator (KJB). Of the 36 patients, 18 (47%) were diagnosed with TN1, 8 (22%) with TN2, 6 (17%) with TNP, 1 (3%) with TDP, 1 (3%) with STN, 1 (3%) with PHN, and 1 (3%) with AFP. The patients' responses to the questionnaire, and their diagnosis (as the desired output) were input into the ANN with two hidden layer multilayer perceptron (MLP). The constructed network was trained with the questionnaire using three runs and one thousand epochs. Using a sensitivity analysis program, the relative importance among the inputs of the neural model and stability of the output in response to variation of an input was investigated, and in doing so, the strength of each question for a specific diagnosis was evaluated.

**Results:** The trained network was able to predict the correct diagnosis for all patients in the sample group with 100% accuracy for every diagnostic category with a final mean square error at a final epoch of 0.003.

**Conclusions:** Artificial intelligence programs have the potential to diagnose trigeminal neuralgia and related facial pain syndromes with high accuracy. A suggested application for this approach includes a patient interactive self-diagnosis internet tool, with direction to appropriate resources. Improved diagnosis will reduce inappropriate treatments for facial pain.

1. Burchiel, Kim J: Neurosurgery 53(5):1164-1167, 2003.

### The Efficacy of Surgery in Refractory Trigeminal Neuralgia; Outcome of 400 Consecutive Procedures.

M. Sam Eljamel, M.B.B.Ch., M.D. and Avinash Haridas, M.B.B.S.

**Introduction:** Trigeminal neuralgia affects 4 in every 100,000 people and is probably one of the worse pains known to man. With relapse, patients often cannot talk, laugh, smile, shave or even eat without experiencing excruciating pain. A significant number fail medical therapy and seek surgical help. The exact cause of this neuralgia in most cases is unknown, however different surgical methods have been developed over the years with variable efficacy. Walter Dandy outlined a theory of vascular compression as early as 1934. However, Peter Jannetta was the first neurosurgeon to apply microvascular decompression (MVD) to treat trigeminal neuralgia. To establish the relative success in treatment of trigeminal neuralgia we reviewed the results of these surgical techniques in 400 consecutive procedures.

**Methods:** A retrospective review of case records, operative log-books, community health index, the birth and death register and a questionnaire sent to family doctors of all patients treated in our institution was undertaken.

**Results:** Four hundred procedures were carried out on 256 patients. More than 50% of these patients were females in the 6<sup>th</sup> & 7<sup>th</sup> decade of life. More than 50% of the procedures were right sided, 37% were percutaneous glycerol rhizotomy (PGR), 36% were percutaneous radiofrequency rhizotomy (PRR), 24% were MVD and the remainder were other ablative procedures.

Although PGR had an initial success rate of 97%, 57% of patients required either a repeat procedure (34%) or a different procedure (23%). The mean duration of symptom control with PGR was 2 years with a procedure failure rate of 2.7%.

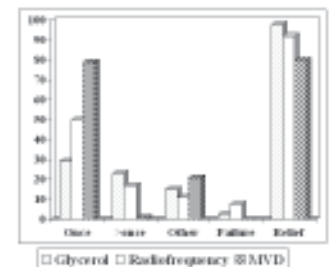
Percutaneous radiofrequency rhizotomy in comparison had an initial success rate of 92%, repeat PRR was required in 21% and other procedures were performed in 14%. The failure rate was 7.5%.

Microvascular decompression on the other hand provided the best long term results with no immediate failures, 79% long-term relief and 21% recurrence rate in the long run.

Eighteen patients (7%) had trigeminal nerve ablation using percutaneous methods in 2% or nerve section in 5%. Although these patients had a long term relief they all had a numb face with anaesthesia dolerosa in 3. The procedures were abandoned early on in this series.

The adjacent figure summarizes the results.

**Conclusions:** Microvascular decompression is the most effective surgical procedure in the treatment of refractory trigeminal neuralgia. Percutaneous glycerol rhizotomy and PRR were both effective in the short term and should be reserved to those who are unfit for MVD. Percutaneous radiofrequency rhizotomy was effective for a longer period of time than PGR and should be the preferred option in those younger unfit patients.



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## Correlation of Preoperative Magnetic Resonance Imaging and Intraoperative Observations of Neurovascular Compression in Patients with Trigeminal Neuralgia

Michael A. Sandquist, M.D., Gary Nesbit, M.D. and Kim J. Burchiel, M.D.

**Introduction:** This study evaluated the utility of MRI in predicting the presence, source, location and degree of neurovascular compression (NVC) in patients with trigeminal neuralgia (TN) who subsequently underwent microvascular decompression (MVD).

**Methods:** Fifty-four patients (17 males and 37 females) with medically-intractable trigeminal neuralgia were prospectively studied. A high resolution MRA (TOF) and gadolinium-enhanced T1 (FSE) MRI, centered on the trigeminal nerve, was obtained in all cases. Our thesis was that MRA would show only arteries, and the enhanced MRI would show both arteries and veins. Bilateral analysis of the MRA source images, and the enhanced T1 MRI was performed by a neuroradiologist blinded to the patient's side of pain, and to the surgical findings. The neuroradiologist determined the presence or absence of trigeminal NVC on the MRA/MRI, whether an artery or vein compressed the nerve, and both the location and severity of NVC, if any. Independently, the surgical findings, as documented by operative videotape of the microdissection, were similarly assessed by a neurosurgeon who was not a member of the operative team. The imaging and surgical assessments were then compared for each patient.

**Results:** Forty-six patients (85.2%) had MRI evidence of a vessel on or near the symptomatic nerve, and 40 (74.1%) showed a vessel in proximity to the asymptomatic nerve ( $p < .2$ ). Magnetic resonance imaging was able to correctly identify the source of NVC (artery or vein) in 43 patients (79.6%), when compared with the surgical findings. Localization of the NVC (superior, inferior, medial, lateral) by imaging was highly correlated with the surgical findings ( $p < .001$ ). More importantly, the degree of NVC (none, simple, compression, dislocation) was found to be significantly greater on the symptomatic nerve ( $p < .01$ ).

**Conclusions:** Magnetic resonance imaging is an effective means of preoperative determination of the presence of, source, location and severity of NVC in patients with TN. Bilateral trigeminal neurovascular relationships are common in TN, but the degree of NVC is significantly greater on the symptomatic side.

## Clinical Efficacy of Radiofrequency Cervical Zygapophyseal Neurotomy in Patients with Chronic Cervicogenic Headache

Jung Yul Park, M.D., Sung Kwon Hab, M.D., Sang Dae Kim, M.D., Se Hoon Kim, M.D. and Dong Joon Lim, M.D.

**Objective:** The purpose of the study was to assess the clinical efficacy of radiofrequency cervical zygapophyseal joint neurotomy in patients with cervicogenic headache to determine whether there was sufficient merit in the procedure to justify its use in these patients.

**Materials & Methods:** A total of thirty consecutive

patients with chronic (> 6 mos of duration) cervicogenic headache who met above criteria and showed greater than 50% of pain relief from diagnostic/prognostic blocks were included. There were 16 men and 14 women with mean age of 54 (range 35-67y). There were no definitive structural abnormalities that could cause neurologic deficits. These patients were treated with radiofrequency neurotomy on medial branch of posterior primary ramus then assessed 1 week, 1 month, 6 month, and 12 months following the treatment.

Radiofrequency generator (Radionics Inc., Burlington, Mass.) with the SMK-C10 cannula (22 gauge; length, 10 cm; exposed tip, 6 mm) was used with appropriate connections and a wide diathermy ground plate. All procedures were monitored by repeated radiographic screening with a movable C-arm image intensifier. Percutaneous radiofrequency neurotomy was performed under aseptic conditions, with the patient lying in the prone position. No sedation or systemic analgesic was used. A needle was placed on the skin surface so that the tip was overlying the target point. The electrode was inserted from a posterior approach along a parasagittal plane, tangential to the lateral margin of the articular pillar, and was directed toward the target point under repeated image-intensifier screening. The target point is a point of intersection of 2 lines diagonally drawn from supero-anterior and supero-posterior to infero-posterior and infero-anterior articular pillar. The levels of lesionings were C3-C4. When the target point was reached, the position of the electrode was confirmed and recorded on antero-posterior and lateral films. Correct position is confirmed by stimulating current for both sensory and motor threshold. Usual thresholds for these were 0.3-0.9 V and 0.6-1.8 V, respectively. The target nerve was then anesthetized by the injection of 1 ml of 1% lidocaine before lesion production. Final lesions were generated at 80°C for 90 seconds. Patients were discharged from the hospital after 1-2 hour observation to see whether there were any signs of discomfort or complications. Follow up visits were made at 1 week, 1 month, 6 month, and 12 months. The following were taken as outcome parameters: Visual Analogue Scale (VAS), number of headache days per week and amount of analgesic intake per week. Successful results were defined if preoperative pain was relieved more than 50%.

**Results:** All patients tolerated the procedure well without additional analgesics or anesthetics. Eighteen (60%), 25 (83.3%), 23 (76.7%), and 22 (73.3%) patients showed greater than 50% of pain relief were seen at 1 week, 1 month, 6 months, and 12 months. The average mean number of headache days per week decreased from 6.2 days to 2.8 days and the average analgesic intake per week showed a 70% reduction. There were no major complications related to the procedures. However, ataxia was seen in 4 patients immediately after the procedure. This was resolved completely within a few hours to 2 or 3 days. Three patients obtained relief that was only short lived (3 months). None of patients reported cutaneous numbness or dysesthesia. However, 12 patients complained of soreness on the neck for 2-7 days following the procedures. These possible symptoms were preoperatively explained to all patients and no specific

# AANS Pain Highlights

**Friday, APRIL 30**

**8:00AM – 5:00PM**

Special Symposium on the Diagnosis and Treatment of Craniofacial Pain and Trigeminal Neuralgia

**Sunday, MAY 2**

**5:00 – 6:00 PM**

**Executive Committee Meeting**

**Monday, MAY 3**

**7:30 – 9:30 AM**

**Breakfast Seminars 110**

Treatment of Complex Regional Pain Syndrome and Hyperhidrosis

**Moderator:** J. Patrick Johnson

**Panelists:** Kim J. Burchiel, Joshua Prager, Vincente Vanaclocha

This seminar will present current management concepts and emerging state-of-the-art techniques and technology to treat symptomatically mediated disorders that include complex region pain syndrome and hyperhidrosis.

**Learning Objectives:** After completing this seminar, participants should be able to:

- ^ Recognize and diagnose complex regional pain syndrome
- ^ Describe treatment options for complex regional pain syndrome
- ^ Discuss current treatment of hyperhidrosis

**Scientific Session III**

**3:30 – 4:00 PM**

Decision-Making for Neurosurgical Treatment of Neuro-pathic Pain

**Speaker:** Mark P. Sindou

**Tuesday, MAY 4**

**7:30 – 9:30 AM**

**Breakfast Seminars 217**

Neurosurgical Management of Intractable Pain: Techniques and Outcomes

**Moderator:** Kenneth A. Follett

**Panelists:** Giovanni Broggi, Marc P. Sindou, Nicholas M. Barbaro, Jaimie M. Henderson

This seminar will review indications, techniques, and outcomes of augmentative and ablative neurosurgical procedures for the treatment of intractable pain. Attention will be directed toward therapies that can be used in a general neurosurgical practice.

**Learning Objectives:** After completing this seminar, participants should be able to:

- ^ Contrast indications for neuroablative and neuroaugmentative surgeries
- ^ Describe techniques of common neurosurgical pain-relieving procedures
- ^ Compare outcome of ablative and augmentative pain surgeries

**Wednesday, MAY 5**

**Pain Posters**

**2:00 – 2:45 PM**

**Scientific Session**

**2:45 – 5:30 PM**

**Moderator:** Oren Sagher and Richard K. Osenbach

This session will serve as a forum for the presentation of topics on the neurosurgical management of pain.

**Learning Objectives:** After completing this session, participants should be able to:

- ^ Identify surgical treatment options for complex regional pain syndromes (RSD and causalgia)
- ^ Appreciate the indications for spinal cord stimulation, intrathecal drug delivery and sympathectomy
- ^ Discuss the advantages and disadvantages

**William Sweet Award Winner**

**846**

**2:45 – 3:00 PM**

Radiosurgical Treatment of Trigeminal Neuralgia: A Prospective Trial of One Versus Two Isocenter Treatment Plan

**Authors:** Robert M. Levy, Brian A. O'Shaughnessy, Alan Kepka, Maryanne Marymont

**847**

**3:00 – 3:15 PM**

Long Term Results of C2- Ganglionectomy for the Treatment of Occipital Neuralgia

**Author:** Jamal Taha

**848**

**3:15 – 3:30 PM**

Trigeminal Branch Stimulation for Treatment of Neuropathic Facial Pain

**Authors:** Konstantin V. Slavin, Christian Wess

**849**

**3:30 – 3:45 PM**

Repeat Radiosurgery for Idiopathic Trigeminal Neuralgia

**Author:** Bruce E. Pollock

**850**

**3:45 – 4:00 PM**

Microvascular Decompression for Trigeminal Neuralgia in Multiple Sclerosis: Results and Physiopathologic Considerations in 35 Patients

**Authors:** Giovanni Broggi, P. Ferroli, Angelo Franzini, V. Nazzi, L. Farina, L. La Mantia

**851**

**4:00 – 4:15 PM**

CT-Guided Cordotomy for the Treatment of Pain of Brachial Plexus Tumor Invasion

**Author:** Jamal Taha

**Special Symposium**

**4:15 – 5:30 PM**

**Moderator:** Richard K. Osenbach

**Spinal Cord Stimulation**

**4:15 – 4:40 PM**

**Speakers:** TBA

**Intrathecal Therapy**

**4:40 – 5:05 PM**

**Speakers:** TBA

**Sympathectomy**

**5:05 – 5:30 PM**

**Speakers:** TBA

*Business Meeting will immediately follow the Pain Section Session.*

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measures were followed, except regular oral analgesics for 2-5 days postoperatively, and all disappeared within a week. Interestingly, most of patients showed more substantial improvement after at least 2-4 weeks following the procedures. There were no instances of postoperative infection or anesthesia dolorosa.

**Discussion:** The term “cervicogenic headache (CGH)” is denoted for the headache that originate from disorders of the neck. It is however not adequately defined and is still controversial whether use of this term is appropriate as two current major international organizations concerned with head pain, namely the International Headache Society (IHS) and International Association for the Study of Pain (IASP), take differing positions to view this condition. Also, view from Sjaastad, who has long been concerned with relations between headache and cervical spine conditions, is another speculation that has been widely accepted in Europe.

Cervicogenic headache is currently described as ‘attacks of moderately severe unilateral head pain without change in side, ordinarily involving the whole hemicranium, usually starting in the neck or occipital area, and eventually involving the forehead and temporal areas, where the maximal pain is frequently located. The headache usually appears in episodes of varying duration in the early phase, but with time the headache frequently becomes more continuous, with exacerbation and remissions. Symptoms and signs such as mechanical precipitation of attacks imply involvement of the neck. A blockade of the greater occipital nerve, the minor occipital nerve, the so-called third occipital nerve, or the cervical roots on the symptomatic side...represents a diagnostic test.’ Pathologic conditions such as fractures, congenital abnormalities, bone tumors, rheumatoid arthritis, whiplash injury, or other distinct pathology all may be related to the development of CGH but authors believe that these should be described with underlying pathologies and those without definitive structural pathologies should only be regarded as CGH.

Major criteria for the diagnosis of cervicogenic headache are (modified criteria):

- I. Unilaterality of head pain, without sideshift
- II. Symptoms and signs of neck involvement:
  - a. Provocation of attacks:
    1. Pain, seemingly of a similar nature, triggered by neck movement and/or sustained awkward head positioning.
    2. Pain similar in distribution and character to the spontaneously occurring pain elicited by external pressure over ipsilateral upper, posterior neck region or occipital region
  - b. Ipsilateral neck, shoulder and arm pain of a rather vague, non-radicular nature
  - c. Reduced range of motion in the cervical spine.

During the last decade, percutaneous radiofrequency neurotomy has been increasingly used in the treatment of chronic cervical pain, and cervicobrachial pain. The rationale for this technique is that nociceptive transmission from the cervical zygapophysial joint and muscles can be blocked by coagulating the medial branches of the dorsal rami, which innervate the joint and muscles. However, there are few

definitive data on the efficacy of such procedures for the cervicogenic headache.

The cervical zygapophysial joints are innervated by articular branches derived from the medial branches of the cervical dorsal rami. The C4-C8 dorsal rami arise from their respective spinal nerves just outside the intervertebral foramina and pass dorsally over the root of the ipsisegmental transverse process. The medial branches of the typical cervical dorsal rami are small (diameter, approximately 1 mm) and curve medially, hugging the waists of their ipsisegmental articular pillars, covered by the tendinous slips of origin of the semispinalis capitis. Each typical cervical zygapophysial joint receives a dual innervation, from the medial branch above and from the medial branch below its location. The medial branches of the C3 dorsal ramus differ in their anatomy from those of lower cervical levels. A deep medial branch passes around the waist of the C3 articular pillar in a manner analogous to that of typical medial branches; this branch participates in the innervation of the C3-C4 zygapophysial joint. The superficial medial branch of C3 is large (diameter, approximately 1.5-2.0 mm) and is known as the third occipital nerve. It winds around the lateral aspect and then the posterior aspect of the C2-C3 zygapophysial joint. Articular branches may also arise from a communicating loop that crosses the back of the joint between the third occipital nerve and the C2 dorsal ramus. Beyond the C2-C3 zygapophysial joint, the third occipital nerve furnishes muscle branches to the semispinalis capitis and becomes cutaneous over the suboccipital region. In this respect, the C3 dorsal ramus is the only cervical dorsal ramus below C2 that regularly has a cutaneous distribution. Those from C4 to C7 typically lack any cutaneous branches. Therefore, on anatomical grounds, pain suspiciously resulting from the C2-C3 levels can be blocked by coagulating the ipsilateral third occipital nerve as it crosses the lateral aspect of the joint, and pain stemming below C2-C3 can be blocked by coagulating the cervical medial branches as they pass around the waists of the articular pillars above and below. The plane of insertion of electrodes is a critical factor. Electrodes must lie parallel to the nerve for the nerve to be incorporated in the radial lesion; under these circumstances, however, the electrode must be within 2 mm of the nerve for it to be adequately coagulated.

With these clinical, anatomical, and technical considerations, authors undertook an audit of our experience with this procedure. The patients selected for study were those who had significant pain relief when diagnostic blocks were preoperatively performed under stringent, controlled conditions. The procedure was based on antecedent anatomical studies of the target nerves; electrodes were introduced parallel to the target nerves, and multiple lesions were made to incorporate the nerves.

**Conclusion:** Although it seems abundantly clear that neck structures play a primary role in the pathophysiology of some headaches, either as a main causal factor or as a cofactor, the clinical patterns indicating a neck-headache relationship have still not been adequately defined. However, with given criteria for such current definition of “CGH” authors believe radiofrequency cervical zygapophysial joint neurotomy seem

to provide substantial pain relief for relatively long duration in patients with chronic cervicogenic headache when carefully selected. However, a definitive conclusion about the clinical efficacy of this treatment should be drawn from a randomized controlled trial with larger population.

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5. van Suijlekom HA, Weber WE, van Kleef M, et al: Radiofrequency cervical zygapophyseal joint neurotomy for cervicogenic headache: a short term follow-up study. *Funct Neurol* 13:82-83, 1998

### Peripheral Stimulation for Treatment of Trigeminal Postherpetic Neuralgia and Posttraumatic Neuropathic Pain: A Pilot Study

Mark D. Johnson, M.D., Ph.D. and Kim J. Burchiel, M.D.

**Introduction:** Neuropathic facial pain occurring after trauma or herpes zoster infection is often refractory to treatment. Although peripheral nerve stimulation has been used to treat occipital neuralgia, its efficacy in the control of posttraumatic neuropathic pain or postherpetic neuralgia in the facial region is not known. We present here a retrospective case series of patients who underwent placement of subcutaneous stimulating electrodes for treatment of trigeminal neuropathic pain secondary to herpetic infection or facial trauma.

**Methods:** Subcutaneous pulse generators and quadripolar electrodes for stimulation of the supraorbital or infraorbital branches of the trigeminal nerve were implanted in ten patients. To determine the results of treatment, medical records from 1998 - 2003 were reviewed retrospectively, and patients were interviewed by independent observers using a standard questionnaire. Information was gathered to assess preoperative symptom duration, degree of pain relief, pre and postoperative work status, postoperative changes in medication usage, overall degree of satisfaction with the therapy, and complication rate. The mean duration of follow-up was 26.6 ± 4.7 months.

**Results:** Peripheral trigeminal nerve stimulation provided at least 50% pain relief in 70% of patients with posttraumatic neuropathic pain or postherpetic neuralgia. Medication use declined in 70% of patients, and 80% indicated that they were mostly or completely satisfied with the treatment. None

of the treatment failures (defined by less than 50% pain relief) occurred in the posttraumatic group, suggesting a trend toward greater efficacy among this group when compared to those with postherpetic neuralgia. The complication rate was 30%. All complications were wound-related problems associated with the electrode extension cable.

**Conclusions:** Peripheral stimulation of the supraorbital or infraorbital branches of the trigeminal nerve is an effective method for relief of neuropathic facial pain occurring after trauma or herpes zoster infection. A prospective trial of this novel approach to the treatment of these disorders is thus warranted. (Manuscript accepted for publication in *Neurosurgery*.)

#### chairman's message continued from cover

educational opportunities on contemporaneous topics at our Annual Meetings. For example, the 2004 AANS Meeting in Orlando will feature a one-day Satellite Symposium on the management of craniofacial pain, scheduled for Friday, April 30, 2004. This Symposium will feature didactic and practical instruction by renowned experts, and should have broad appeal to neurosurgeons. Since many neurosurgeons encounter patients with trigeminal neuralgia and a host of other craniofacial pain syndromes, I strongly encourage neurosurgeons to attend, regardless of their specialization. In addition to the Craniofacial Pain Satellite Symposium, the Meeting will feature an afternoon symposium on contemporary management of complex regional pain syndrome. I encourage everyone to attend these offerings.

Beyond the Annual Meeting, there are other opportunities for neurosurgeons to become involved in pain management. For those clinicians interested in learning the techniques involved in implantable therapies, there are a number of courses offered by the manufacturers of these devices as well as non-profit organizations (e.g. the Dannemiller Memorial Educational Foundation). These courses are routinely headed and taught by neurosurgeons expert in the field, and are excellent resources. For those interested in more in-depth training, there are a number of post-graduate fellowships offered as well. Please contact the Pain Section and we will be happy to provide a list of institutions you can contact.

Finally, I would encourage those of you who are not involved in the Pain Section to become members in the Section. Membership in the Pain Section not only enables you to receive timely updates on pain related topics, but also identifies your interest in pain treatment with other physicians, medical institutions, and patients. Please let me know if there are other ways in which the Pain Section can serve your needs. I can be reached by e-mail at [osagher@umich.edu](mailto:osagher@umich.edu), or call me at 734-936-9593. I welcome your comments and suggestions on Section activities and resources.



Oren Sagher, M.D.



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**Eligibility:** Members of the AANS and/or CNS who are actively interested in the management of pain problems.

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Signature of Applicant

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Date

**Please return completed application with your membership fee of \$50 to:  
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